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THE EXTENSION OF THE FULL-TIME PLAN OF TEACHING TO CLINICAL MEDICINE[1]

YOU have done me the honor to invite me to speak to your graduating class at your commencement exercises. Let me tell you how much I appreciate it, and how glad I am of the opportunity to affirm my profound faith in the special fitness of women for the medical profession. As practising physicians, the large numbers of successful women, of whom your city and your school have had many conspicuous examples, make the question of their value a closed subject. There are perhaps fewer women working on the scientific side of medicine, but no one would now advocate eliminating the work of a Madame Curie, because of a prejudice against the sex of the worker. In relation to education, may I call your attention to the fact that yesterday the Johns Hopkins University honored a woman, Miss M. Carey Thomas, retiring president of Bryn Mawr College, because she is one of the outstanding educators of our day. She has a relation to medical education because her vision and her profound faith in the value of the college training as a preparation for medical education had raised the standards of medical education in this country. Thus it seems to me that the question of giving women a medical training has now been settled, but there is one place where women who are now studying may increase rather than decrease the prejudice against giving women adequate chances for a medical education, namely, if the women who have been adequately trained so lightly give up all use of that training when they marry. English women have been able to carry on the practice of medicine after mar-

[1] Address delivered at the seventieth commencement exercises of the Woman's Medical College, Philadelphia, Pennsylvania.

riage and it is quite possible for married women to do scientific work or public health work of a high order if they have the ability and the training, so there is no reason why the responsibility to the community for using expert training should not be forcibly presented to our students. Indeed, one of the next steps in the feminist movement is for educated married women to claim and to carry on a share of professional work.

I desire, however, to speak this morning on a subject of more general interest in medical education, a subject which it may be possible to apply only to medical schools connected with univerrsities at the present time but one of such general importance to the medical profession that I most earnestly bespeak for it your sympathetic interest. I refer to the extension of the so-called full-time scheme to the clinical branches.

About thirty years ago, the full-time plan of teaching was introduced into the pre-clinical departments of our medical schools. At that time the pre-clinical sciences were unproductive servants of the clinical branches and were taught by practicing physicians as a side issue; they are now represented by professional anatomists, physiologists, chemists and pathologists. No one questions the value of the change. The idea was but the extension into the medical training of the fundamental principle that teaching is a highly specialized profession. It has not been very long since the presidents of our colleges were ministers, now they are professional educators. The thought that it was now time to apply the same principles of education to the clinical branches that had wrought so much progress elsewhere can be traced, I think, to the late Professor Mall and Mr. Abraham Flexner. The experiment is now being tried in several of our medical schools which are a part of universities, but the plan is having an even more difficult time to win support than did the earlier experiment with the scientific side. It is not yet clearly understood by our students and has therefore not yet won their enthusiastic sympathy; and it is still actively opposed by some of the medical profession. The reasons for these difficulties are threefold: first, the failure to keep the fundamental principles involved distinct from personalities; second, the greater complexity of the actual scientific problems involved, and third, certain practical difficulties in putting the plan into effect.

The fundamental principle, as I see it, is a recognition of the value of education to the community. It states boldly that a great educator in clinical medicine is as great an asset to the community as a great practitioner of medicine. To set any great value on teaching runs counter to popular belief. If you are accustomed to look facts in the face you will admit this to be true. You all know the phrase, "he who can, does; he who can not, teaches." You all remember that the most frequent criticism of Wilson was that his training had been only that of a teacher. In Wells' history there is a statement of the exact truth about education; that we treat it in a beggarly, niggardly way. The funds for education are in part an endowment that is given by a few people; and, in part, they have been won from unwilling and uncomprehending legislatures. What a pitiful contrast do the sums we spend on teaching make with the sums we spend on war!

In studying the problem, it is first essential to analyze the relation of research to teaching. On the scientific side, it is now established with sound wisdom that all teachers should be engaged in research. It is based on the idea that universities shall be the home of intellectual progress; that they should have a double function, the advancement of knowledge and the training of those who shall carry it on. Research is the teacher's own professional work, it is that which he does; it makes plain to his students and to his colleagues the quality of his mentality and it is his contribution to the knowledge of his day. Only to minds of feeble comprehension does the carrying on of research mean any lessening of the value of teaching; research lifts teaching to a higher plane. It is perhaps better to say that no one can be a really great educator unless he is himself an investigator, either in the subject matter or in the methods of education, and can lead students, in part, into research, and, in part, to carry into all work the spirit and

method of research. It may here be made clear that no school expects all of its students to undertake scientific investigation; indeed only a part and perhaps but a small part of the student body either want to or are fitted for it, but our schools must hold in research those who are to be the next generation of teachers. Thus the extension of the full-time scheme throughout the medical training means putting the entire medical training into the hands of professional educators.

The full-time scheme in clinical medicine substitutes research to be associated with teaching, instead of the practice of medicine. The progress of medicine of the past thirty years has brought us face to face with something quite new, namely, with preventive medicine as a reality instead of a dream. We need no longer say diseases may disappear, but diseases are disappearing. It is this fact that calls for something really profound in the reorganization of medical education. When I began the study of medicine twenty-six years ago, we learned clinical medicine mainly in the typhoid wards. In the fall nearly everything on the medical side gave way to typhoid; now our students hardly see it. The most vivid memories of my year of internship are of typhoid tubs and the elaborate reasons for believing in them; our students will now carry away the impression of the value of sanitation and the efficacy of typhoid vaccine. In China, last summer, the contrast between preventive and palliative medicine became clearer to my mind than ever before. I was hearing of deaths from malaria and discussions as to whether it was wiser for the traveler to take small preventive doses of quinine or not, some saying that the subsequent treatment in case of infection was less effective if these preliminary doses had been taken. I knew that in reality only certain places at home had really eliminated malaria; but I also knew that our own department of clinical microscopy was having a difficult time to get enough blood infected with malarial parasites to teach our students the characteristics of the organism. With our present knowledge it is easy to see that the better way for China to deal with malaria is to get rid of mosquitoes rather than to import quinine, but it is just as clear that until there is money enough and enough of a civic organization in China to undertake sanitation, the palliative treatment of each case of malaria is the only feasible plan. At least it is easy to see which type of work has the greater ultimate value, the research which shows that the mosquito is the intermediate host of malaria and shows how to eliminate the disease or the discovery of the effect of quinine and the treatment of each case. Such a contrast by no means disparages the skill of clinical diagnosis and treatment; it is quite clear that palliative medicine must remain as the measure of the failure and ignorance of preventive medicine. In the full-time scheme as applied to clinical medicine, we recognize that preventive medicine has so far advanced that we can demand that the few leaders of medical education shall have as their major intellectual interest the growth of scientific medicine. The actual dealing with the sick is an ancient and honorable profession; but the science of preventive medicine is a profession on a still higher plane and it is now legitimate to ask that those who are teaching in a profession which is thus changing shall themselves contribute to that change. The research which brings new methods is of greater ultimate value than the immediate practical application of our present knowledge.

It must again be emphasized that practical applications of knowledge are in no way to be despised. The practise of medicine must be palliative but I should here like to pay tribute to the progress of curative medicine. There has developed on the clinical side of modern medicine a degree of expert skill in diagnosis of which I believe many workers on the purely scientific side are unaware and underestimate. Our students must acquire this skill; there are certain parts of the medical training where I believe our students should be really expert when they are graduated, namely: in the technique of clinical microscopy, in the methods of medical and surgical diagnosis, and in the aseptic technique of modern surgery. In their attitude toward curative medicine, those who are working on the scientific side should keep clearly in mind that the amount of curative medicine necessary is the measure of the defi-

ciencies of their own branch of the work. To make up these deficiencies of preventive medicine we must continue to develop the curative side, but beside the technique of curative medicine our students must now have also a training that shall enable them to continue to develop with the growth of medical knowledge and this, the greatest asset of an education, demands educational institutions that are themselves the sources of such growth.

It is frequently said by those who oppose the full-time scheme, that workers in laboratories do not possess technical clinical skill. It is true; moreover, those who are to teach on the clinical side must have clinical skill, their work must be with patients. But for those who are to be our clinical teachers the contrast is not between the laboratory and the clinic but between private practice as against practice with patients in hospitals. From the standpoint of acquiring skill and experience for the doctor, it seems to me that there can be no question but that the advantage lies in having patients in hospitals. To illustrate, Osler's well-known text-book of medicine was written as a record of his experience and that of his colleagues in dealing with the sick in the Johns Hopkins Hospital. One might make it still stronger and say that it is only in hospitals that studies and records of clinical material adequate enough to make any large contribution to clinical medicine can be made. Indeed, to go back historically, the early studies on tuberculosis of the great French physician, Louis, were made from records of patients in a hospital and started the idea that the hospital is the laboratory of clinical material. Indeed, at the present time many of the exceptionally successful physicians in private practice are developing hospitals of their own of which the Mayo clinic is a conspicuous example. For surgery, practically all of the work has already been transferred to hospitals, and for medical practice, the advantages to the patient are producing the same change. Thus, even if it be admitted, and it can not be doubted, that for the study of disease the hospital has every advantage over the home, still the opponents of the full-time scheme have often claimed that on the side of making human contacts, of learning how to deal with people, the private practitioner has a kind of experience that a teacher and a physician who deals only with patients in hospitals never acquires—I deny it. The school and hospital are as much a part of the world as the sick man in his home. The same ability to have really great influence in dealing with people makes toward success in a hospital or in a class room as in a private practice. There are two facts, however, which we should recognize, if we want to see all sides of the question. First, the teacher is somewhat artificially protected from the consequences of poor work. The teacher is always dealing with minds that are immature in his particular subject; and in the organization of our educational system the criticisms of students, that is, of those who are most affected by inefficient teaching, are allowed but little weight. I understand that in England students are not so docile as with us. Moreover, the very low salaries paid to teachers have led institutions to offer security of tenure as a compensation. We should recognize this, our institutions should set an adequate value upon the profession of teaching, and should demand high standards of work. Secondly, hospitals develop a routine in which the feelings of people are forgotten. If many of our hospitals had more of the spirit of exceedingly efficient service that characterizes our best hotels, there would be less room for legitimate criticism of caring for the sick in institutions. I do not think that this criticism applies so much to the smaller hospitals, but in some of the larger ones, where the actual medical work is done exceedingly well, the management of the institution could learn much from efficient business.

Thus we are quite willing to admit the deficiencies of our present educational system; we believe that it should be subjected to criticism, for it is better that its faults should be known than concealed. We recognize all the advantages of curative medicine, and that our present skill in dealing with disease represents a great achievement; nevertheless, we believe that the whole of medical education should be in the hands of professional educators who will recognize that the still more brilliant achieve-

ments of preventive medicine have brought us to a stage where we need to reorganize clinical teaching on the basis of research. To my mind this is the fundamental point and the final argument. Up to this time, preventive medicine has been left for the most part to chance and to boards of public health who applied what knowledge they had but attracted to their services, for the most part, only men of moderate ability. The reorganization of medical schools consists in focussing the minds of the ablest men in the profession on the problems of advance in medicine in contrast to the ideas associated with the practical applications of knowledge. This is the meaning of stressing research instead of the practical side in educational institutions.

On this plane, I believe that you will admit the principle of the full-time scheme. What are the practical difficulties? The first one is due to the complexities of clinical problems. If you analyze the progress of scientific medicine, it is astonishing how many of the discoveries that have really changed medicine in any fundamental way have come, not from the clinics, but from the laboratories; for example, diphtheria antitoxin, the whole treatment of infections by means of serums, and the discoveries of the action of the glands of internal secretion. In fact, in connection with this latter subject, there is abundant reason to demand that clinical applications of our knowledge shall measure up to the standards of sound physiological experiments. It is obvious that the materials of research are more readily handled in the laboratory than in the clinic. In the laboratory ideas can be subjected to experiment and the number of variables can be limited in these experiments in a manner not possible in dealing with patients. In the early days of the application of the idea of the full-time plan to clinical work, the first research done in clinical laboratories was pure anatomy, pure physiology and pure chemistry and was done no better than it was being done in the pre-clinic departments. It was asked and asked legitimately if there is such a thing as pure clinical research. Already we see light in this matter. There have now developed certain combinations between the workers in the pre-clinical departments and the clinics of advantage to both. I may instance the brilliant progress which has come from the laboratories of nutritional chemistry and the departments of pediatrics in the study of rickets. Here three different techniques have been brought to bear on a problem of profound interest to clinical medicine, namely, the nutritional experiments of McCollum combined with the clinical and histological methods by Park and Shipley. In the nutritional experiments on rats, McCollum and Simmonds have not only been able to produce rickets but other bone deficiencies as well and are now analyzing the effects of sunlight as well as of diets on these deficiencies. Indeed, the brilliant results in nutritional chemistry of Hopkins in England, of Mendel and McCollum in this country, demand an extension to the clinical field as a logical conclusion of their work.

Surgery gives another example of a place where such combinations are of value, for in surgery we are now passing into a phase where further progress depends on a utilization of various methods of the pre-clinical sciences. The actual technique of surgical operations has now reached a high degree of perfection and any great advance in surgery now depends on a more searching analysis of the reactions of tissues to surgical procedures. Indeed, if I may cite a particular example, we have in Dr. Halsted a man who has not only contributed very greatly to surgical technique during its period of marked development, but has also used surgical technique and the insight which his clinical experience has given him toward solving the problems of scientific medicine. Such an instance is to be found in his work on the thyroid, where he demonstrated that a graft of a thyroid gland does not take in an animal until an artificial deficiency has been produced.

On the other hand, there are certain problems with which it seems to me that the hope of progress lies with the underlying sciences. There are certain subjects where all the results which can be expected from simple methods have been obtained and where progress must be made by going deeply into the underlying causes. Such problems are to my mind illus-

trated in connection with blood and with the subject of the etiology of malignant growths. In connection with anemias, for example, we have had a complete survey of all the types of blood-cells that appear in the circulation under abnormal conditions, so that the hope of success now lies in a very careful study of the fundamental origin and relation of the types of blood-cells in the hope of finding out how to stimulate them differentially. If you will permit me to speak for a moment of my own work, it is now possible to cut out the blastoderm of a chick and watch it develop under the microscope, in a hanging drop preparation. In such a preparation, one can see the development of the blood-cells in the embryonic membranes of the living specimen. On the second day of incubation only red cells arise and they can be seen to come from the endothelial walls of the blood-vessels. The white cells on the other hand begin to appear on the third day. They come in part from new cells that differentiate directly from mesenchyme without becoming a part of the lining of a vessel. Moreover, the type of the white corpuscles that come from endothelium, namely, the monocytes, have the same kind of phagocytic activity, with the storage of phagocytized material, that characterizes the parent endothelium. These observations seem to me to open up anew the question of relationship of the white cells of the blood, from the standpoint of their classification on the basis of function. In connection with the great subject of new growths it is clear that we now await the discovery of their fundamental cause and that toward this discovery we need certain very fundamental biological studies in connection with the reactions of cells to normal and abnormal conditions; such as, for example, are involved in the investigations of Loeb, Murphy and others.

Problems which can be solved by purely clinical methods, or problems which need for their completion the application of clinical methods are not lacking. Indeed, their roots cover the whole period of modern medicine. In the full-time scheme, it is the argument that these problems can be solved at enormously greater advantage by a group of men concentrating their interests on the study of patients in hospitals rather than in private practice. The idea involves changing the emphasis of the interests of the leaders of the medical profession from the application of knowledge to the cure of disease, to the study of the problems of disease. It is, I believe, clear that, in the development of medicine, there is a very wide range of problems that are immediately feasible, some of them to be attacked in the laboratories of the pre-clinical sciences, some in the wards of hospitals, and some by combinations of workers in laboratories and in the clinics; but that all of them will gain by being in the hands of those to whom their solution is a major interest seems absolutely certain.

In the development of a group of scientific workers in direct connection with clinics who are actually engaged in applying the technique of the underlying sciences to clinical problems, there have grown up two groups of workers doing the same kind of work, one in connection with the clinics and the other in the pre-clinical departments. In this connection there have come discrepancies in salaries, the workers on the clinical side receiving the higher salary and ultimately the greater reward. The student becomes interested in research while still a student and finds that if he joins a clinical staff and does the same type of work that he might have done in a pre-clinical laboratory he will gain more respect from the university. Already there is beginning to be some surprise that such a system works against the fundamental sciences. It is said frankly that a man who keeps in touch with the clinical branches has a greater earning capacity in the community than the man who severs his connection with practice and devotes himself to the fundamental sciences. This in my judgment is a direct challenge to the leaders of universities to renew their faith in the kind of work for which universities exist. They must remedy this condition before the laboratories are depleted of their workers; they must show clearly that in estimating the use of a university they do not accept the popular estimate of the value of the practice of medicine over and above its study; and

finally that they have a clear view of the merits of preventive as compared with palliative medicine. The public would always pay more to have a given case cured than to have all cases of a given disease prevented, but leaders of universities must not fall into this error. Universities should rather lead than follow public opinion. In great contrast to public opinion, it is interesting to note that the most conspicuously successful and hard-headed business man of our time has judged it wise to make his total contribution toward the study of disease. The condition of discrimination against the fundamental sciences is also a menace to universities unless they wish to lose the abler men in the pre-clinical branches who have proved themselves fundamental on two scores, on making progress, and on training workers in the methods of research. I do not believe that increased salaries of those engaged in educational work will come through any organization of teachers. The associations of teachers have always been based on the principle of improving their professional standards instead of seeking for personal gain. The profession of teaching is concerned in a very fundamental way with the ideals of giving and helping, rather than receiving. But there are signs that the community as a whole is beginning to think of the value of education. Progress through the light of reason may not be rapid, but there lurks in the minds of all of us a memory of the poison gases of the late war and a consciousness that no antidotes are to be found against them except through trained minds. It is only with regret that one appeals to the educational force of war, but it can not be escaped. It is probable that the contact of the university with the increased earning capacity of modern medicine and with the need in commercial life for men trained in science will work out to the advantage of education in two ways, first, in the bringing of more adequate funds to education, and second, in the drawing of abler people into universities, thus raising the standards of teaching.

I have claimed that the idea at the root of the full-time scheme is better teaching and more research. In the practical working out of the plan it has not always been clear that the balance of high ideals of teaching lies with the full-time scheme. If this were made clear the plan would readily win the support of the entire body of students. By the time a student has reached the third and fourth years of the medical course, he has no longer the idea that teaching does not matter; he really wants help and guidance. Marked ability to teach is not common; exceptional ability is as rare in teaching as it is in any other profession. A man who is practicing medicine may easily have as much ability to teach as a man who is doing research, and indeed, in many of the medical schools, there are practicing physicians who are doing excellent work in teaching. The universities have asked these men to teach, giving them either no salaries or salaries that are merely nominal, and have expected them to gain compensation in experience as an asset to the practice of medicine. The full-time scheme must not be considered as an attack on these men but merely as the next step in the progress of medical education which demands that educational institutions shall now select, and draw into their teaching force, a group of men who shall devote their entire energy to teaching and research. If this can be done, one can hardly question but that the advances of the past thirty years of professional teaching of the pre-clinical side will be duplicated on the clinical side.

It is clear that two factors have given us a very much larger staff of teachers on the clinical than on the pre-clinical side. The first is the legitimate factor of the development of the great number of specialties. The second is the fact that many clinical teachers have put only a small part of their time into teaching and the fact that the custom of the medical school of paying them practically nothing has made it easy to increase their numbers. With the change of emphasis on teaching and research, it is obviously impossible to put all of this large group on the full-time basis with adequate salaries. The change can be made rapidly in the organization of new institutions but must be made gradually in the older ones, where only a few of the teachers in the main branches of medicine and surgery, together with representatives of some of the specialties,

varying according to local conditions, can be put on the full-time plan in the beginning. This can be done with the confident expectation that the principle which is the more sound toward improving education will win out in the end.

The development of modern scientific medicine with all its expert skill, and especially the skill of modern surgery, has brought the same possibilities of exaggerated financial reward into medicine that has followed the development of machinery into industry. Moreover, in the practise of medicine, a chair in a great institution serves as the same enormous financial asset as advertising in business. These facts are conspicuous and hence overestimated. The number of men making conspicuous wealth in medicine is not large. The skill of the physician deserves an adequate reward. Unfortunately it has been made to appear as if the fundamental reason for the full-time scheme was an attack on commercialism in medicine. It is not true; the fundamental reason is much more profound, more constructive, it concerns the development of higher ideals of research and teaching. It is true that the development of the full-time scheme makes large demands in terms of ability; it needs men with ability for research, for teaching, and for organization, but men for whom ideals and the chance for a brilliant achievement may outweigh the pursuit of excessive wealth. I say excessive wealth advisedly; the advantages to the community have already been so enormous in the development of scientific medicine, and it is so logically the next step to bring clinical medicine under the principle underlying this progress, that it should be possible to give adequate support to this new development.

I said at the beginning that there had been considerable opposition on the part of the medical profession to the full-time scheme. This opposition I believe to be due to a lack of understanding of the principles involved and to the difficulties of transition. One certainly hears some suggestion, vaguely expressed, perhaps not wholly consciously formulated, of a fear of preventive medicine. To this there can be only one answer. To preventive medicine the medical profession must adjust itself. It is obvious that eliminating typhoid, malaria, typhus, smallpox, cholera and so forth have so far not emptied our hospitals nor diminished the need for doctors; indeed, along with preventive work, many conditions have come into the range of treatment which were formerly untouched, so that up to the present time the effect of preventive medicine has been expressed largely in a lengthening of the expectation of life. This fact, together with the eliminating of many of the weaker schools of medicine, makes it sure that the effects of preventive medicine on the profession belong to another generation, not to ours. When the time comes, the medical profession will make the only possible adjustment of training fewer physicians.

In conclusion, I may say that I do not think that all the problems associated with the practical extension of the full-time scheme to the clinical side have been solved. Adjustments may have to be made, perhaps radical ones, but I profoundly hope that the plan will be given an adequate trial and that it can win the support of those who are teaching in our medical schools, because I believe it of the utmost importance to the community to range the ablest minds in the medical profession on the side of preventive medicine. Besides an occasional school of hygiene and public health we need to have all of the leaders of medical education engaged in research to advance medicine. It is my sincere conviction that the opposition to extending the modern standards of professional education to clinical medicine will yield readily to sound constructive leadership on the part of those who desire this reform.

FLORENCE R. SABIN
THE JOHNS HOPKINS MEDICAL SCHOOL

PRELIMINARY REPORT ON AMERICAN BIOLOGICAL STAINS

As previously mentioned in this journal,[1] a committee was organized under the auspices of the National Research Council last fall for

[1] "The Standardization of Biological Stains," SCIENCE N. S. LV, 43-44; Conn, H. J.: "American Biological Stains Compared with Those of Grübler," SCIENCE, N. S. LV, 284-285.

the investigation of the biological stains produced in this country. This committee is working in cooperation with the Society of American Bacteriologists, the Botanical Society of America and the American Society of Zoologists. Through the cooperation of these different organizations stains are being tested in their bacteriological applications, and in their histological and cytological uses, both in connection with zoology and botany. The field is a very large one and in some lines the work is only just barely started; but enough information has been obtained in connection with certain uses of some of the stains so that a preliminary report is justified at the present time.

The most important conclusion reached in this work is that in general as good stains can be obtained in this country now as were available before the war. In some cases the American products are distinctly better than were the Grübler stains. The only important stains we have so far failed to find in satisfactory quality in this country are methyl green and safranin. In regard to these it must be mentioned that not all Grübler samples were satisfactory, some of the samples we have tested which were of unquestionable Grübler origin proving as unsatisfactory as the poorest American samples. It must be remembered that Grübler did not manufacture stains, but bought from other concerns in large quantities, and the constancy of his stains was due wholly to the large bulk he was able to buy at once, on account of the large market which he supplied. In general his stains were in no sense pure, and one of the greatest difficulties in this country at present is that as soon as a biologist obtains poor results with a stain he immediately calls for a purer product, which the manufacturer tries to supply, often obtaining stains that are too pure to be used by the same formulæ originally used with Grübler stains. It is not purity so much as agreement with the Grübler products in staining properties that should be desired.

It is hoped that eventually one line of stains may come to have official approval in this country, not necessarily all manufactured by the same house but the production of each stain limited to one concern, so that responsibility of its manufacture can be definitely fixed. Arrangements for this have not yet been made and can not be until more preliminary investigation has been carried on, but at the present time it is possible to recommend certain brands of the most common stains for certain particular purposes.

METHYLEN BLUE

There are various grades of methylen blue on the market, but so far as we have been able to find out, one grade, namely, the medicinal grade generally designated as methylen blue U.S.P., seems to be satisfactory for all purposes. This is the purest grade of methylen blue on the market and, although there are other grades of slightly less purity, designated by such terms as "BX" or "rectified for blood stains," which are perfectly satisfactory for staining purposes, nevertheless the difference in price between them and the medicinal grade is insignificant. It is the committee's recommendation, therefore, that methylen blue U.S.P. be regularly specified. The following brands have been very carefully tested for bacteriological purposes and prove to be very satisfactory. Indications are that they can be used equally well in histological work, although for this purpose they have not been so fully tested. These brands are: Coleman and Bell Company, National Aniline and Chemical Company and Providence Chemical Company.

Of these three brands, the first and last mentioned have been tested in vital staining of shrimps and sea worms. In this work quite a large number of other methylen blues were run for comparison. Of those tested, the sample of medicinal methylen blue from the Providence Chemical Company was the only American sample of known manufacture to compare with Grübler's methylen blue for bacilli when used for this purpose. Only one report on the stains used in this way has been received, but as it is by a specialist in this line of work the results are regarded as quite conclusive.

FUCHSIN, BASIC

This stain has been tested for two different purposes: (1) Staining bacteria, primarily the tubercle organism; and (2) for use in the Endo medium for differentiating the colon and

typhoid organisms. For staining bacteria several satisfactory samples have been found, namely, those obtained from Coleman and Bell, Dicks, David & Co., the Goldin Biological Laboratories, the H. S. Laboratories, National Aniline and Chemical Company, the Newport Chemical Works and the Providence Chemical Company. Used in the Endo medium all of these samples have given as good results as Grübler's basic fuchsin, but one of them, namely, that of Coleman and Bell, gives even better results for this purpose than Grübler's samples or any of the others tested.

GENTIAN VIOLET

Gentian violet is not a textile dye. It is not recognized in the regular dye industry and is not listed in Schultz's index, the recognized list of textile dyes. The name was apparently introduced by Grübler and is certainly found nowhere except in the literature relating to biological stains. Grübler's gentian violet was a mixture of various pararosanilin dyes, but its exact composition is a little difficult to determine because of conflicting statements that have been made about it. Somewhat simpler mixtures of these pararosanilin dyes are known to the textile trade under the name of methyl violet, the name being followed by a designation indicating the shade such as B, 2B, 3B, etc.

The methyl violets are regarded as being various mixtures of the following three compounds: Tetramethyl-pararosanilin, pentamethyl-pararosanilin, hexamethyl-pararosanilin, which differ from each other as the names imply in containing 4, 5 and 6 methyl groups respectively to the molecule. The more highly methylated the compound, the bluer its shade, and as in the trade designation of these dyes the number of B's following the name indicates the depth of the blue in the violet, it may be assumed that the more highly methylated compounds are distinguished by the greater number of B's, although these trade designations do not refer to definite chemical formulæ. In the case of methyl violet 5B, 6B and 7B, there is apparently a still different compound introduced in which one or more of the methyl groups have been replaced by benzyl groups.

Only two of these compounds have to our knowledge been put upon the market in a pure form, namely, the pentamethyl and the hexamethyl compounds. The former of these has been claimed to have been obtained pure for use in microscopic work but has never been put on the market widely. The latter is a well-known textile dye sold under the name of crystal violet.

It will thus be seen that there are quite a variety of dyes and biological stains all falling within the group commonly referred to by biologists as gentian violet. Now that it is certainly difficult, and perhaps impossible, to obtain the same mixture sold by Grübler as gentian violet, it becomes a question just what to use in its place. Certainly it is not wise to purchase "gentian violet" at the present time, because every dealer has his own idea as to what to sell under this name and the different gentian violets at present on the market vary from pure crystal violet to various mixtures of methyl violets with crystal violet, some of them possibly containing other dyes as well.

The first point, therefore, that the committee wished to test was as to what dye to substitute for gentian violet. The work so far done along this line has been mostly in connection with the Gram staining technic, the procedure for which the bacteriologist most frequently employs this stain. Work is at present in progress to see whether the conclusions reached in this work will apply also to this stain when used for histological purposes. The indications are that they will.

It has been found that for the Gram stain the compounds of low methylation such as those known under the names methyl violet, methyl violet B and methyl violet 2B are rather unsatisfactory, but that methyl violet 5B and crystal violet can be well substituted for gentian violet. Now, crystal violet is a definite chemical compound and is generally recognized as a textile dye; hence, the source of supply is much more constant than in the case of any of the other dyes in this group, and it seems to be the most logical substitute to use. The committee therefore recommends that, except for work where it is known that crystal violet will not work, this dye be substituted for gentian violet, and that it be regularly substituted for it in the Gram stain for bacteria.

There seem to be but two sources of crystal violet in this country—namely, the du Pont Company and the National Aniline Company. The du Pont product we have tested and found to be of very good quality. The National Aniline product was not obtained in time to include in the cooperative tests, but upon examination by the writer it appears to be entirely satisfactory for the Gram stain.

Crystal violet can be obtained from nearly all the dealers in biological stains but we are informed that nearly all of them buy the du Pont product and rebottle it without any purification or standardization. The du Pont Company does not sell this dye in small bulk, so when ordered for staining purposes it is well to buy it through one of the dealers in stains but to specify the product desired. The National Aniline Company sells crystal violet both in bulk as a dye and in small containers as a stain.

If gentian violet is ordered it is recommended that it be purchased from one of the following concerns, all of which have been tested for the Gram stain and found to be very satisfactory: Coleman and Bell, Goldin Laboratories, H. S. Laboratories, National Aniline and Chemical Company and Providence Chemical Company.

In using any of these dyes it must be remembered that owing to the presence of a large amount of dextrin and possibly other impurities in the Grübler product the American stains are two to four times as strong. This must be allowed for in preparing the formulæ. Those formulæ which call for a definite amount of saturated alcoholic solution of gentian violet do not need to be changed, but those calling for a definite number of grams per 100 cc. must be modified to suit these more concentrated products.

HÆMATOXYLIN

One source of American hæmatoxylin proves to be very satisfactory for general purposes and is specially recommended for cytological work. This is the c.p. product prepared by McAndrews and Forbes. It is handled by all of the dealers in stains but generally without indicating the manufacturer on the label. Although this is probably the only c.p. hæmatoxylin on the market and is handled without modification by every concern that deals in these products, nevertheless users of this stain are recommended to specify the McAndrews and Forbes product in order to discourage dealers of these stains from omitting the manufacturer's name from the bottles when all they do themselves is to rebottle the stains. The McAndrews and Forbes hæmatoxylin has been enthusiastically endorsed by practically every one who has used it, generally with the statement that it is better than some Grübler samples.

EOSINE

The situation in regard to eosine is not quite so satisfactory, but even in this case it is not discouraging. The Grübler samples of eosine seem to have varied considerably, certain samples proving poorer than certain American samples and others distinctly better. For the present it can merely be said that the most promising American samples so far tested have been those from the Geigy Chemical Company and from the Heller and Merz Company, among the manufacturers, while among the dealers in biological stains, apparently satisfactory samples have been obtained from D. H. Pond of Cleveland, Ohio, from the Providence Chemical Company and from Coleman and Bell. The latter has been tested with good results in Mallory and Wright's methylen-blue-eosine formula. These samples have also been used in counterstaining against hæmatoxylin in histological work and for staining red blood cells, and have proved distinctly better than the Grübler samples submitted for comparison with them but not as good as some Grübler samples that the individual investigators have had on hand in their laboratories. These results must be regarded as very preliminary findings. Further work is now in progress and it is hoped in a later report to have more definite information in regard to eosine. For the present no definite recommendations are made. It is suggested that where unsatisfactory results are obtained in counterstaining against hæmatoxylin, Orange G may be substituted for eosine to great advantage.

ORANGE G

Samples of Orange G have been tested from Coleman and Bell, the du Pont, the Geigy

Chemical Company, the Grasselli Chemical Company, and from the National Aniline Company. All of these have been found to work satisfactorily as a counterstain with the hæmatoxylin. They all seem to be more concentrated, however, than the Grübler product and have a tendency to overstain, especially if used in alcoholic solution. In aqueous solution, although they give a slightly browner color than Grübler's Orange G, they have proved very satisfactory. Any tendency to overstain can be counteracted by using weaker solutions. The results are not yet complete but are very encouraging so far as they go.

PYRONIN

Some difficulty has been experienced in obtaining a good American source of pyronin, which is now considerably used in the Pappenheim stain and as a counterstain in the Gram technic. Only two samples have so far been tested under the direction of the committee, one from Providence Chemical Company and the other from the National Aniline Company. The former proves satisfactory, the latter less so. Other concerns list this stain, but their products have not yet been tested. More work on this stain is now in progress.

S. I. KORNHAUSER
F. W. MALLORY
F. G. NOVY
L. W. SHARP
H. J. CONN
Chairman
Committee on Standardization of Stains,
National Research Council
GENEVA, N. Y.

GEORGE BRUCE HALSTED

GEORGE BRUCE HALSTED, son of Oliver Spencer and Adela (Meeker) Halsted, was born at Newark, N. J., November 25, 1853. He received the degrees of A.B. (1875) and A.M. at Princeton, and Ph.D. (1879) at Johns Hopkins.

For a few years he was instructor in post-graduate mathematics at Princeton, then (1884-1903) professor of mathematics in the University of Texas. Here he rendered with marked success his most important services as a teacher of mathematics. After leaving this institution he was professor of mathematics at St. John's College, Md. (1903), and at Kenyon College, Ohio (1903-6), and finally at Colorado State Teachers' College (1906-12), when he retired from teaching and devoted himself to practical work in electrical engineering. Six or seven years later his health began to fail and in 1921 it broke down completely, so that he could not do any work. He spent his last few months in hospitals and sanitariums, and finally passed away, March 16, 1922, at the Roosevelt Hospital, New York.

After retiring from teaching, Dr. Halsted continued his labors in the field of mathematics so far as his occupation permitted, nor did he abandon them, even after his failing health had become serious, until further work was physically impossible.

At Johns Hopkins he studied under Sylvester, for whom he had the greatest admiration and from whom he seems to have imbibed the view that, whatever else mathematics may be, it is poetry. To this fact may possibly be due his inclination to employ poetic diction in discussing mathematical subjects.

Dr. Halsted was preeminently a geometrician, though he wrote some articles on higher mathematics. He was an ardent devotee of non-Euclidean geometry. Some of his utterances justify the opinion that he believed, not only that space is a genus comprising more than one species, but that our space is actually non-Euclidean and (with Riemann) that, though boundless, space may be finite. He wrote several works on geometry (including mensuration) one of which was translated and republished in France. He wrote many articles for periodicals, most of them on non-Euclidean geometry. He also contributed articles to the *Century Dictionary* and the *Encyclopedia Britannica*. He translated a good many works, written in different modern languages and two written in Latin—Bolyai (the well-known *Appendix*) and Saccheri (*Euclides Vindicatus*). He seemed to attach more importance to his having translated these two works and Lobatschewsky's non-Euclidean geometry than to anything else he ever did. When he was compelled to cease from work of any kind he

was preparing a translation of Saccheri's *Logica Demonstrativa* from a copy which he believed to be the only one extant.

He married Margaret Swearingen, who, with three sons, survives him.

ARTHUR M. HUMPHREYS
UNIVERSITY OF VIRGINIA

SCIENTIFIC EVENTS

THE FOULERTON PROFESSORSHIP AND STUDENTSHIPS OF THE ROYAL SOCIETY[1]

THE Council of the Royal Society gives notice that it has created the Foulerton research professorship, and that the appointment of a professor will be made on the advice of a committee of fellows called "The Foulerton Research Fund Managing Committee." The stipend will be £1,400 a year, and the duty of the holder of the professorship will be to conduct, in a place approved by the committee, such original researches in medicine or the contributory sciences, on lines approved by the committee, as shall be calculated to promote the discovery of the causes of disease and the relief of human suffering. The appointment will be in the first place for five years, but may be renewed for further periods of not more than five years at a time. The normal retiring age will be 60, but a professor may be continued in exceptional cases for a further specified period. Arrangements are being made for superannuation under the federated superannuation system for universities, and the professor will be required to devote the whole of his time to research. The holder of a paid academic or other scientific appointment may, however, be nominated, provided the committee is satisfied that the duties of such other appointment occupy only a subsidiary portion of the applicant's time and that its retention would not interfere with the discharge of the duties of the professorship as essentially a whole-time research appointment. In such case the committee would recommend a reduction of the stipend, of such amount, however, as shall not reduce the total annual income of the professor from his paid appointment and from the fund below £1,400. The appointment will only be made if candidates of sufficient distinction present themselves. The Royal Society also gives notice that it is prepared to appoint one or more Foulerton research students. The duties of a Foulerton research student will be to conduct researches in medicine or the contributory sciences under the supervision and control of the committee, to whom the student will be required to report from time to time on the progress of his work. The studentship will be for three years, but may be renewed from year to year until it has been held for a maximum period of six years from the first award. In recommending a person for appointment as student, the committee will have in view the expressed wish of the donor that awards should be made especially to young workers. The stipend is £700 a year, and a studentship will normally be regarded as a whole-time appointment, but in exceptional cases the holder may be allowed to retain a paid teaching post; in that case the committee may recommend the payment of such stipend as it may think fit. A candidate may be called upon to show that he or she is and that his or her father and paternal grandfather are, or were at the date of the respective deaths, of British nationality. Applications for the professorship or studentship, for both of which members of either sex will be eligible, must reach the Royal Society not later than October 31 next.

[1] From the *British Medical Journal*.

APPOINTMENTS AND PROMOTIONS AT THE JOHNS HOPKINS UNIVERSITY

IN THE FACULTY OF PHILOSOPHY

Joseph T. Singewald, Jr., Ph.D., associate professor, to be professor of economic geology.

IN THE FACULTY OF ENGINEERING

Frederick W. Lee, Ph.D., associate, to be associate professor of electrical engineering.

J. Trueman Thompson, B.S. in Eng., associate, to be associate professor of civil engineering.

IN THE FACULTY OF HYGIENE AND PUBLIC HEALTH

William W. Ford, M.D., associate professor, to be professor of bacteriology.

Carroll G. Bull, M.D., associate professor, to be professor of immunology.

Robert W. Hegner, Ph.D., associate professor, to be professor of protozoology.

Linda B. Lange, M.D., instructor, to be associate in bacteriology.

IN THE FACULTY OF MEDICINE

Warfield T. Longcope, M.D., professor of medicine.

Harold L. Amoss, M.D., associate professor of medicine.

Robert S. Cunningham, M.D., associate, to be associate professor of anatomy.

William S. McCann, M.D., associate, to be associate professor of medicine.

Arthur L. Bloomfield, M.D., associate, to be associate professor of medicine.

Benjamin Kramer, M.D., associate, to be associate professor of pediatrics.

Esther L. Richards, M.D., associate, to be associate professor of psychiatry.

Albert Keidel, M.D., associate, to be associate professor of clinical medicine.

Wilburt M. Davison, M.D., instructor, to be associate in pediatrics.

Leslie B. Hohman, M.D., instructor, to be associate in psychiatry.

Phyllis G. Richter, M.D., instructor, to be associate in psychiatry.

Emil Novak, M.D., instructor, to be associate in clinical gynecology.

Mary N. Buell, Ph.D., associate, to be associate in physiological chemistry.

Ernest H. Gaither, M.D., instructor, to be associate in clinical medicine.

J. Earle Moore, M.D., instructor, to be associate in clinical medicine.

Wilder G. Penfield, M.D., associate in neurology.

Edwin G. White, Ph.D., associate in urology.

Alfred G. Kolls, M.D., associate in physiology.

DEDICATION OF THE UNIVERSITY OF COLORADO MOUNTAIN LABORATORY

THE construction of a laboratory building in the mountains near Boulder at an altitude of 10,000 feet marks a new departure by the University of Colorado. The erection of this building is the outgrowth of the field work in geology that has been conducted for the past ten years by Dean W. E. McCourt, of Washington University, St. Louis, and of the University of Colorado Summer School.

The laboratory building is constructed of logs which were hewn from the mountain side in the vicinity. It contains a working laboratory, a kitchen and an office. Sleeping quarters for students and the staff are provided in house tents. The building is located near to the university camp, a summer recreation camp conducted by the associated students of the university, some thirty miles from Boulder. The camp and laboratory are accessible by automobile over good mountain roads.

The dedication of the laboratory building was conducted by the Colorado chapter of the Society of the Sigma Xi on July 22. At these exercises addresses were delivered by Dean W. E. McCourt, Dean O. C. Lester, of the University of Colorado, and Professor F. K. Richtmyer, of Cornell University. Dean McCourt explained the character of work that is being conducted in geology in the mountains. The immediate vicinity of the laboratory has a wealth of varied geological formations which supply an abundant material for class study and research. Dean Lester pledged the support and cooperation of the Graduate School of the university in the project and expressed the hope that this unpretentious beginning may flourish and grow into a formidable institution.

The main address of the occasion was delivered by Professor F. K. Richtmyer, of Cornell University, who, in conjunction with Dr. F. E. Lutz, of the American Museum of Natural History, is spending the summer in the mountains near Boulder investigating the relation of color of flowers to insect visits. Professor Richtmyer spoke on "Sigma Xi and Research." He reviewed the history of Sigma Xi and explained the character of the work that the society is conducting at the present in the stimulation of original investigation. After the formal program Professor Richtmyer and Dr. Lutz explained the character of the problem they are investigating and exhibited the results they have obtained so far.

Besides the work in geology, the university plans to conduct field courses in biology from this mountain laboratory. The fauna and flora in the vicinity of the camp are abundant and varied. It is hoped to enlarge this plant in a few years and to provide facilities for geological and biological investigators of the

country who may wish to spend a summer in the mountains. The usual cool weather and the abundant recreational facilities make the mountains an ideal place for summer work.

I. E. W.

PROGRAM ON CONSERVATION OF THE SECTION OF SOCIAL AND ECONOMIC SCIENCES OF THE AMERICAN ASSOCIATION

SECTION K will hold several sessions at the Boston meeting devoted to the various aspects of our natural resources and their conservation. Invitation papers by many leading specialists have already been promised. This program will constitute a symposium, or a series of symposia, that promises to be nationally of very great importance. It will interest all scientists and all workers in education, as well as all who are looking forward toward the betterment of national and international welfare and living conditions generally. The section is particularly fortunate in having, as its vice-president and chairman for the current year, Colonel Henry S. Graves, dean of the School of Forestry of Yale University. The tentative program for these sessions, as far as it has been arranged, is given below, with the names of those who have been invited to present papers. The majority of those invited to speak have already accepted.

Introductory address, by the vice-president and chairman, Colonel Henry S. Graves, dean of School of Forestry, Yale University.

I

THE CONSERVATION OF HUMAN AND MATERIAL RESOURCES

1. *The conservation of human energy,* by DR. THOMAS S. BAKER, secretary, Carnegie Institute of Technology, Pittsburgh, Pennsylvania.
2. *Conservation of labor power,* by DR. L. C. MARSHALL, School of Administration, University of Chicago.
3. *Conservation of health,* by DR. EUGENE R. KELLEY, state health commissioner of Massachusetts.
4. *Conservation of motherhood,* by DR. H. B. HEMENWAY, State Health Department, Springfield, Illinois.

II

CONSERVATION OF FUEL AND POWER

5. *Our national coal problem,* by DR. D. L. WING, Washington, D. C.
6. *Economic aspects of the oil problem.* (Not yet assigned).
7. *Conservation of power,* by MR. WILLIAM S. MURRAY, Grand Central Terminal, New York.
8. *Problems of flood control,* by GENERAL HARRY TAYLOR, in charge of government flood control work, Corps of U. S. Army Engineers, Washington, D. C.
9. *Conservation and industrial waste,* by DR. JOHN T. BLACK, state health commissioner, Hartford, Conn.

III

CONSERVATION OF CAPITAL AND CREDIT

10. *Conservation of capital,* by MR. H. T. NEWCOMB, general solicitor, Delaware & Hudson Company.
11. *Conservation of wealth through insurance,* by MR. CHAMBERLAIN, superintendent of the Group Insurance Department, Travellers Insurance Company, Hartford, Conn.
12. *Conservation of America's economic independence,* by DR. FREDERICK L. HOFFMAN, dean of Advanced Department, Babson Institute, Wellesley Hills, Mass.

IV

CONSERVATION AND RURAL DEVELOPMENT

13. *The national problem of land reclamation,* by MR. F. H. NEWELL, Washington, D. C.
14. *Problems of rural economics,* by PROFESSOR E. G. Nourse, chief of agricultural economics, Iowa State College.
15. *Conservation of the qualities of the rural population,* by DR. KENYON L. BUTTERFIELD, president Massachusetts Agricultural College.
16. *Home economics,* by MR. C. F. LANGWORTHY, States Relation Service, Washington, D. C.

V

CONSERVATION OF FOREST RESOURCES

17. *The forests of the world,* by MR. RAPHAEL ZON, forest economist, U. S. Forest Service, Washington, D. C.
18. *Economic aspects of our timber supply,* by COLONEL W. B. GREELEY, chief forester, U. S. Department of Agriculture.
19. *Forest research and the forestry movement,* by PROFESSOR R. T. FISHER, head of Division of Forestry, Harvard University, Cambridge, Mass.

20. *State policy in forestry,* by MR. W. A. L. BAZELEY, state conservation commissioner of Massachusetts, Boston, Mass.
21. *Forestry and rural development,* by COLONEL HENRY S. GRAVES, dean of the School of Forestry, Yale University.

VI

CONSERVATION OF NATIONAL PARKS AND SCENIC RESOURCES

22. *Our scenic resources and their practical uses,* by DR. G. F. KUNZ, president, American Scenic and Historic Preservation Society, New York City.
23. *Our national park policy in its economic aspects,* by MR. ROBERT STERLING YARD, secretary of the National Parks Association, Washington, D. C.
24. *Conservation of waters of medicinal and healing value.* (Not yet assigned).

VII

CONSERVATION OF GAME RESOURCES AND WILD LIFE

25. *Economic aspects of game conservation,* by MR. F. C. WALCOTT, fish and game commissioner, Hartford, Conn.
26. *Conservation of our whale fisheries,* by DR. JOHN FRANKLIN CROWELL, economist, New York City.
27. *The migratory fish problem,* by DR. R. E. COKER, U. S. Bureau of Fisheries.

FREDERICK L. HOFFMAN,
Secretary of Section K
WELLESLEY HILLS, MASS.

SCIENTIFIC NOTES AND NEWS

ALEXANDER GRAHAM BELL died on August 2 at his summer home in Nova Scotia. Dr. Bell was born in Edinburgh on March 3, 1847.

DR. W. J. HOLLAND, since 1898 director of the Carnegie Museum, Pittsburgh, has become director emeritus. He is succeeded in the directorship of the museum by Mr. Douglas Stewart.

PRESIDENT JOHN BRACKEN, of the Manitoba Agricultural College, Winnipeg, formerly professor of field husbandry at the University of Saskatchewan, is to be the next premier of Manitoba.

MORE than 500 of the pupils and friends of Professor L. Bolk, of the chair of anatomy at the University of Amsterdam, recently presented him with his portrait painted in oils.

DR. F. T. ASCHMANN, chemist to the Pennsylvania Bureau of Foods at Pittsburgh, has been elected chairman of the board of chemists of the bureau, to succeed the late Professor William Frear.

DR. W. H. BRITTAIN, provincial entomologist for Nova Scotia, has been appointed a member of the council of the American Association for the Advancement of Science, to represent the Canadian Society of Technical Agriculturists.

DR. F. P. VEITCH, of the Bureau of Chemistry has been appointed by the secretary of agriculture as a member of the special committee on government paper specifications. This committee will prepare and submit to the congressional joint committee on printing specifications for paper for public printing and binding.

DR. J. A. AMBLER has been appointed chemist in charge of the Color Laboratory of the Bureau of Chemistry. Dr. Ambler has been acting chief since the resignation of Dr. H. D. Gibbs.

DR. W. H. RANKIN, Ph.D., plant pathologist for the Dominion of Canada, has been appointed an associate in research (plant pathology) at the New York State Station, effective July 1, and will take up a special study of diseases and insects affecting raspberries, particularly in the Hudson River Valley. This work has been made possible by a special grant by the legislature. D. W. Carpenter, Ph.D., assistant professor of physical chemistry at the University of Iowa, has been appointed associate in research (chemistry), beginning on July 1. W. L. Kulp, assistant in research (biochemistry), has resigned, effective on the same date, to accept a teaching fellowship in bacteriology and biochemistry at Yale University, the vacancy being filled by the transfer of Millard G. Moore, assistant chemist.

E. E. CLAYTON, Ph.D., extension plant pathologist at the Ohio State University, has been appointed pathologist at the newly established field station on Long Island. H. C. Huckett, a graduate student at Cornell Univer-

sity, has been appointed associate entomologist, beginning on July 1.

MR. R. E. ZIMMERMAN, formerly director of the research laboratory of the American Sheet and Tin Plate Company, has been made assistant to the vice-president. Mr. J. W. Whetzel, formerly research associate, has been appointed manager of the research laboratory, and Mr. E. S. Taylerson, formerly physicist, is now assistant director.

MR. R. L. HOWARD, associate professor of chemistry in the Medical College of Virginia, has been awarded the research fellowship in pharmacology at Western Reserve University.

THE University of Brussels has conferred the "Docteur spécial en sciences physiologiques" on I. Newton Kugelmass, M.A. (Columbia), Ph.D. (Johns Hopkins), for his researches, "Physico-chemical studies of the mechanism of blood clotting."

DR. HENRY HANSEN, chief of the Department of Public Health of Peru, who since 1919 has been combating yellow fever there, arrived in New York on August 5 for a visit. Dr. Hansen went to Peru from the Rockefeller Institute at the request of the Peruvian government.

DR. AARON ARKIN, professor of pathology and bacteriology at the West Virginia School of Medicine, Morgantown, has been granted a year's leave of absence for study and research abroad. He will spend the year in Vienna, Berlin, Paris and London.

DR. W. P. WILSON, director of the Commercial Museum of Philadelphia, has been appointed by Governor Sproul of Pennsylvania commissioner to represent the state at the centennial of Brazil opening on September 7. He will represent also the city of Philadelphia. Dr. Wilson has in addition been appointed delegate from the Academy of Natural Sciences of Philadelphia and from the Smithsonian in Washington, by Secretary Hughes, to the Congress of Americanists meeting about the twentieth of August in Rio de Janeiro.

PROFESSOR THEODORE W. RICHARDS, of Harvard University, spoke before the Société Chimique de France on July 12 on "La signification actuelle des poids atomique."

DR. T. CASPAR GILCHRIST, of Baltimore, delivered the annual oration, on the progress of dermatology, before the London Dermatological Society.

DR. WALTER B. CANNON gave an address on "What has been accomplished by animal experimentation" during the recent meetings of the Pacific Northwest Medical Association.

A LEGISLATIVE bill that recently passed the French Chamber of Deputies, as we learn from the *Journal* of the American Medical Association, provides for the granting of an appropriation of 3,620,000 francs to enable the state to participate in the commemoration at Strasbourg of the centenary of Pasteur. The committee delegated to inquire into the project has reported that the centenary should be celebrated not in Strasbourg alone but also in Paris and in various cities of Franche-Comté in which Pasteur lived—particularly Dôle, Lons-le-Saunier, Arbois and Besançon. The committees on public instruction and public health, after hearing M. Strauss, minister of public health, who spoke in the name of the government, reached the same conclusion and decided to request the government to modify the scope of the centenary by eliminating the two words "at Strasbourg." Acting on the suggestion of M. Deville, in turn, the municipal council of Paris has unanimously voted an appropriation of 50,000 francs for the celebration at Paris of the centenary of Pasteur.

AN appeal has been made for subscriptions to a proposed memorial to Sir German Sims Woodhead, late professor of pathology in the University of Cambridge. It is proposed that the memorial shall take the form of a portrait relief in bronze, to be placed in the library of the Medical School at Cambridge, and that it shall correspond in design to those of Professor Woodhead's predecessors in the chair of pathology, the late Professors Roy and Kanthack.

PROFESSOR J. J. MACKENZIE, head of the pathological departments of the University of Toronto, died on August 1 at the age of fifty-seven years as a result of infection contracted during his experiment with the pus-forming bacteria.

DR. AMBROSE ROBINSON WILLIS, who for many years taught mathematical physics at the Royal College of Science, died on June 23, at the age of seventy-two years.

DR. HARVEY CUSHING, of Harvard University, has been awarded the Charles Mickle Fellowship of the faculty of medicine of Toronto University. He has accepted the fellowship, which is for $1,000, but has stipulated that the money shall be used to send one graduate of the University of Toronto to Harvard to work with him. The Charles Mickle Fellowship, bequeathed by the late Dr. W. J. Mickle, is the annual income from an endowment of $25,000 and is awarded annually to the member of the medical profession anywhere who is considered to have done the most during the preceding ten years to advance sound knowledge of a practical kind in medicine. The first award was made last year to Professor I. Pawlow, of the University of Petrograd.

PROFESSOR A. SOMMERFELD, professor of mathematical physics at the University of Munich, will be in residence at the University of Wisconsin for the first semester of the coming academic year 1922-23, holding the Karl Schurz memorial professorship in the university for that period. Professor Sommerfeld is expected to give a three-hour course on "Atomic Structure" and a second three-hour course either on the "Analysis of Wave Propagation," or a three-hour course in "The General Theory of Relativity." The Karl Schurz memorial professorship in the University of Wisconsin was founded in 1910 as an exchange professorship with the German universities. The appointment of Professor Sommerfeld marks the resumption of the professorship after the interruption caused by the war. Before the days of the Civil War, Karl Schurz was a resident of Watertown, Wisconsin, and served on the board of regents of the State University. The memorial professorship was founded in recognition of his distinguished services to the state and nation.

THE following appointments have been made in the Food Research Institute of Stanford University: *Special investigators*—Wilfred Eldred, Ph.D. (Harvard), recently professor of economics at the University of Virginia, who for nearly a year has been carrying on investigations in the baking industry for the institute, and John L. Simpson, A.B. (California), who in 1919 was liaison officer of the food section of the Supreme Economic Council and chief of the A. R. A. Commission to Serbia, and in 1920 special correspondent to the New York *Evening Post* for eastern Europe. *Research assistants*—Susan S. Burr, A. B. (Vassar), A.M. (Stanford); Franklin D. Schurz, A.B., M.B.A. (Harvard); A. G. Silverman, A. B. (Harvard). *Fellows*—Edith Hawley, A.M. (Columbia), a graduate student at Columbia for the past two years; James N. Holsen, A.B. (Indiana), A.M. (Princeton); Olaf S. Rask, A.B., B.S. (Minnesota), a graduate student at the University of Minnesota and formerly a research chemist in the Bureau of Chemistry, U. S. Department of Agriculture; William B. Stewart, A.B. (Reed), a graduate student at the University of Illinois; and Conrad P. Wright, A.B. (Oxford), a graduate student at the University of California.

WE learn from the *Journal* of the American Medical Association that Dr. R. P. Strong, of the Harvard Medical School, who has just returned from his fourth trip to Panama, has announced that it has been decided to establish first divisions of bacteriology, pathology, protozoology, helminthology, biochemistry, entomology, plant pathology and animal diseases in the new Gorgas Memorial Institute of Tropical and Preventive Medicine, at Panama. These departments will be organized with laboratories for research work, particularly in connection with the study of the mode of spread of the most important infectious diseases of man and animals. There will be close cooperation between the institute and the Ancon Hospital and Leprosarium. In addition to the foregoing subjects, tropical botany and the biologic effect of sunlight will also receive attention. Provision will be made for the instruction of a limited number of students, the courses of instruction to be designed especially for those who have had laboratory training before. A limited number of research workers will also be received. Dr. Strong

states that, since the president of a small South American republic, already overtaxed, had donated a memorial to an American, it was the duty of all American citizens, not only American physicians, to provide a suitable endowment fund with which to carry on the work of the institute.

THE conference of the British Museums Association has noted: "That in the opinion of the Museums Association the time has arrived when it is desirable in the interests of the country to appoint a royal commission to investigate and report upon the work of museums in relation to industries and general culture."

AT its recent meeting, the Eugenics Research Association voted that it was its sense that Germany should be granted membership on the International Eugenics Commission.

THE Canadian Horticultural Council, which was recently organized with headquarters at Ottawa, has taken steps towards the organization of a system for the registration of new varieties of plants. Through the agency of Mr. W. B. Lobjoit, controller of horticulture for Great Britain, the secretary of the Canadian Horticultural Council will be kept informed of the efforts being made not only in England but on the continent, to provide a means for the registration of horticultural plants, shrubs and trees. The secretary of the council has also got into touch with the horticultural authorities in the United States who are interested in this matter. It is expected that a conference on the subject will be arranged for during the present year.

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of Miss Harriet S. Hazeltine, Middlebury College receives $25,000.

ACCORDING to the *Bulletin* of the American Mathematical Society, the title of the chair of "differential and integral calculus" in the University of Paris has been changed to "the theory of groups and the calculus of variation."

DR. MARCUS P. NEAL, assistant professor of pathology and bacteriology at the State University of Iowa College of Medicine, Iowa City, has accepted a position as professor of pathology and bacteriology at the University of Missouri School of Medicine, Columbia.

DR. LEROY S. PALMER, associate professor of agricultural biochemistry in the University of Minnesota, has been promoted to a full professorship.

S. W. GEISER, Ph.D. (Johns Hopkins), has been appointed assistant professor of zoology in Washington University, St. Louis.

F. B. ISELY, dean and professor of biology at Culver-Stockton College, Canton, Missouri, has accepted a similar position with Texas Woman's College at Fort Worth, Texas. L. S. Hopkins, of Kent, Ohio, becomes dean and professor of biology in Culver-Stockton College.

MR. ELIOTT FROST has resigned his position as director of the Industrial Management Council of the Rochester Chamber of Commerce to accept the headship of the department of psychology at the University of Rochester, the directorship of its Department of Extension, and of its Summer School.

DISCUSSION AND CORRESPONDENCE

THE SPECTRUM OF HELIUM IN THE EXTREME ULTRA-VIOLET

MR. FRICKE and I showed (*Phil. Mag.*, 41, May, 1921) that in the extreme ultra-violet the arc spectrum of helium probably contained but one line with a wave-length near 585 A.U.

I have recently attacked the subject again, using a vacuum spectroscope so arranged that a good vacuum could be maintained in the body of the apparatus while the discharge tube contained helium at a pressure of about a millimeter. No window was employed, the success of the device depending on the use of a very short and narrow slit and upon the suitable application of a powerful pump.

With a continuous current the line at 584.4 is of very great strength, and is accompanied by three new lines at 537.1, 522.3 and 515.7 whose intensities decrease with their wave-length and in a manner strongly suggesting a series relation. Luckily the first three members appear in the second order spectrum, a

comparison with the hydrogen line 1215.68 and with the three following lines of the same series is therefore possible, with the result that the wave-lengths are probably correct to one or two tenths of a unit.

The spacing of these four helium lines on the frequency scale is of great interest and importance, for it is found to be identical with the spacing of the first four lines in the singlet principal series. It may be stated therefore with considerable certainty that the line 584 forms the first member of a principal series, which, according to the notation of Professor Fowler, is to be represented by oS-mP.

Besides this series there is a single line at $600.5 \pm .3$ of a feeble and diffuse character; its origin is not entirely above suspicion. In the extreme ultra-violet the arc spectrum of helium appears to contain no lines in addition to those just mentioned.

The relation between the accepted values of the resonance and ionization potentials in helium and the wave-lengths of these new lines is rather puzzling. The ionization potential should certainly correspond to the limit of the oS-mP series; now this limit can be accurately calculated, it corresponds to 24.5 volts but the experimental value is 25.3 volts. This is the chief difficulty, but it is not the only one, for the agreement between the wave-lengths of the individual spectrum lines and the values of the resonance potentials as determined by Franck and Knipping is not satisfactory. A correction of about —0.8 volts if applied to all the potential measurements will bring the two sets of data into fair agreement but at the expense of the first resonance potential which is left without any corresponding line in the spectrum.

The matter should be of some interest to those who are struggling with the model of the helium atom.

THEODORE LYMAN

JEFFERSON LABORATORY,
HARVARD UNIVERSITY,
AUGUST 3, 1922

THE CALIFORNIA POPPY

IT is perhaps strange that students of genetics have not given more attention to the plant which is the glory of California fields, the Copa d'Oro or California poppy, *Eschscholtzia californica* chamiso. It is a plant easily raised from the seed, remarkably affected by external conditions as well as subject to marked variations, fluctuations or mutations, which could be readily confirmed or intensified by selective breeding.

So great is the variability of this plant that Greene has separated the ordinary perennial form into thirty-two different "species," while of the eight or nine other forms, annuals, closely related to the golden poppy, but tangibly distinct from it and from each other he defines seventy-three species with some outlying varieties. To this incredible list, Fedde, a German botanist, adds several more. There is in fact no limit if we regard every peculiar plant as the type of a new species, without evidence as to the origin and permanence of its variation. Such a condition, as observed by Darwin among cirripeds, is attractive to us "as speculatists, however odious to us as systematists."

The flowers of *Eschscholtzia californica* are normally of a deep, rich orange, the four petals with entire edges an inch and a half long. Near the seashore the flowers are smaller, of a more or less clear lemon yellow, orange at base or not. This is apparently "ontogenetic" variation, not entitled to a systematic name, because likely to disappear with a changed environment, as the plant is not only inherently variable but responds directly to all changes of soil and season.

Towards the end of a rainless summer, the upright flower stalks wither and flowers successively smaller spring from near the rootstock. These are of a clear lemon yellow, sometimes more or less orange at base, the orange fading as the flower grows smaller.

Just now looking from my window as I write over a field golden with blossoms, I see numerous variations, some of them perhaps to be called mutations, as they are quite striking and, occurring in patches must be more or less permanent. In several areas the flowers are of a light creamy yellow, the petals holding their place when plucked longer than in the orange form. Another group has large flowers

of a citron color. On some plants the petals are more or less laciniate on the margin. Frequently they are five in number, sometimes six, often eight. The number of pistils is not fixed, and the bifid cotyledon and broad rim of the torus, both traits normally characterizing the true *californica* (the smooth perennial), are often as elusive as the other characters.

The color especially lends itself to modification by selection. Burbank once found a plant with a crimson streak like a red thread at the base of each petal. Saving the seed, he obtained through selection alone a poppy with the flowers all crimson. Seedlings from Burbank sometimes have pinkish flowers, almost white.

Eschscholtzia has certain advantages over the evening primrose for experimental purposes. It is a natural species occurring by the million in its habitat. Though very difficult to transplant, it grows readily from the seed. It is therefore not a garden variant, nor a suspected hybrid. *Œnothera lamarckiana,* thus far the subject of most mutation experiments, though cultivated in Europe, is American in origin. No one, I believe, has yet ever found it growing wild anywhere.

In any event, accurate studies of the variation in *Eschscholtzia* should be interesting and repaying.

DAVID STARR JORDAN.

THE TEMPERATURES OF METEORITES

IN the last number of SCIENCE[1] Dr. George P. Merrill discusses some matters connected with meteorites. With regard to their temperature he says, "it seems certain that they have been wandering for an indefinite period in space and at a temperature of 'absolute zero.' At the time of entering our atmosphere it is fair to assume that they are cold throughout to a degree of which we can have no conception." It has seemed to me worth while to examine roughly what temperature a meteorite might reasonably be expected to have just before it enters the atmosphere of the earth. The meteorite has certainly been for some time exposed to radiation from the sun, and it may well be that its temperature is much higher than the absolute zero.

To get some idea as to the temperature suppose that the meteorite is a sphere with a black surface, and that the material of which it is composed is a perfect conductor of heat. The temperature of this sphere is determined by the condition that the rate at which it loses heat by radiation equals the rate at which it receives heat from the sun. The condition is expressed by the equation

$$4\pi r^2\sigma\theta^4 = \pi r^2 b\frac{e^2}{d^2}, \qquad (1)$$

where r stands for the radius of the meteorite, σ for the constant in the Stefan-Boltzmann radiation formula, θ for the absolute temperature of the meteorite, b for the solar constant, and e and d for the respective distances of the earth and the meteorite from the sun. If we take σ as $1.279\cdot10^{-12}$ cal./cm^2.sec.deg.^{4} and b as 1.93 cal./cm^2.min. (1) leads to

$$\theta = 282\sqrt{\frac{e}{d}}. \qquad (2)$$

Thus if black spheres which conduct heat perfectly were placed at the same distances from the sun as the several planets, (2) shows that the temperatures of these spheres would be the following:

At the distance of	
Mercury	180° C.
Venus	58° C.
Earth	9° C.
Mars	—45° C.
Jupiter	—149° C.
Saturn	—182° C.
Uranus	—209° C.
Neptune	—221° C.

We see that in the neighborhood of the earth such a sphere would have a temperature above that of melting ice!

But a meteorite is not a perfect conductor of heat. Suppose we apply the above method of reasoning to a sphere which is a perfect non-conductor of heat, covered, except along a narrow equatorial line, by a thin layer of a substance which is a perfect conductor of heat and is black. The conducting layer forms two separate caps, and if one cap is turned toward the sun and the other away from the sun we

[1] SCIENCE, 55, p. 675, 1922.

find, when the sphere is as far from the sun as the earth is, that the cap which faces the sun will have a temperature of about 62° C. The other cap will be at the absolute zero of temperature, so that the average temperature of the sphere will be about —105° C. We may, therefore, conclude that if a meteorite were spherical and black its temperature when near the earth would lie between —105° C. and +9° C.

If the meteorite is not a perfect conductor of heat the temperature of the inside will not usually be the same as that of the outside. The amount by which the temperature of the inside differs from that of the outside will depend in part on the thermal conductivity of the meteorite and in part on the rapidity of motion toward the sun or away from it, as well as on the distance from the sun. Suppose that the meteorite is a sphere and has a diffusivity of 0.01 cm.²/sec. This is about the diffusivity of limestone and is less than that of granite. Suppose further that this sphere is at the absolute zero of temperature and is suddenly placed where its surface is maintained at 9° C. Then for a sphere 10 cm. in diameter I find[2] that at the end of fifteen minutes the difference between the temperature at the center and that at the surface will be less than 15°, at the end of twenty minutes the difference will be less than 5°, and at the end of thirty minutes it will be less than 0.2°. If the meteorite travels 100 kilometers a second it would require nearly five days to go a distance equal to that from the orbit of Venus to the orbit of the earth. So, unless the meteorite travels much faster than 100 kilometers a second, or is much more than 10 cm. in diameter, it seems likely that the temperature of the inside can not be very different from that of the outside. This, of course, is before the meteorite enters the atmosphere of the earth.

As another way of attempting to get some idea as to the temperature of a meteorite suppose we consider the temperature of a cylinder. Let the cylinder be at the same distance from the sun that the earth is. Let the ends of the cylinder be black, and let one of them point directly at the sun. To simplify matters suppose that there is no radiation from the sides of the cylinder. Then the heat which reaches the end that is turned toward the sun is partly radiated from that end and partly conducted to the other end and there radiated. From this condition we obtain the equations

$$\sigma(\theta_1^4 + \theta_2^4) = b \qquad (3)$$

and

$$\theta_1 = \theta_2 + \frac{l\sigma\theta_2^4}{k}, \qquad (4)$$

where θ_1 and θ_2 stand for the absolute temperatures of the two ends of the cylinder, and l and k stand for the length and thermal conductivity of the cylinder. Taking k as 0.008 cal./cm.sec.deg., which is about the value for granite, equations (3) and (4) lead to the following results.

Length of cylinder	Temperatures of ends		Average temperature of cylinder
1 cm.	61° C.	63° C.	62° C.
10 cm.	52° C.	70° C.	61° C.
100 cm.	4° C.	98° C.	51° C.

In the actual case there would, of course, be considerable radiation from the sides of the cylinder, so that the temperatures would be lower than those given in the above table.

Although these calculations do not tell us precisely what the temperature of a meteorite may be expected to be just before it enters the atmosphere of the earth, they do seem to be sufficient to indicate that that temperature is nearer to 0° C. than to the absolute zero of temperature.

ARTHUR TABER JONES

SMITH COLLEGE

[2] From eq. (44) on p. 133 of Ingersoll and Zobel, *The Mathematical Theory of Heat Conduction.*

THE BUREAU OF STANDARDS

TO THE EDITOR OF SCIENCE: Considering the enormous interest taken even by the non-discriminating newspaper public in the achievements of the Bureau of Standards, which scientific men are justly proud of as one of the greatest physical laboratories of the world, using physics in its proper sense of including chemistry and engineering, or ap-

plied physics, your readers may be interested in the following letter, which I have just unearthed, in one of those single-handed combats in the perennial struggle against dirt, in which an armistice has just been declared. (Pardon the lack of unity in the preceding sentence. It at least does not contain the word "due," nor the adverbial phrase "back of," meaning behind).

I had written an article, the first in English, describing the Physikalisch-technische Reichsanstalt in Charlottenburg, which I had seen in its initial stages, and urging to the best of my ability the establishment of such an institution in this country. This article I had sent to the *Popular Science Monthly,* from whence it was returned with a note from the editor, Dr. Youmans, saying he did not believe that such things were the function of the government. What to do with it I did not know, but finally Dr. G. Stanley Hall took pity on the little wanderer, and published it in his *Pedagogical Seminary,* and the U. S. post-office did the rest. I sent copies to Sir Oliver Lodge, who read an article on the same matter at the meeting of the British Association, but I never heard whether he got them. It was probably as a result of his paper that the National Physical Laboratory was founded. The United States, as usual, brought up the rear. It was not until eight years after my article that the first step was taken leading to the establishment of the Bureau of Standards, which now, in size and expenditure at least, leads all the rest. This is due to the extraordinary tact and skill in management of its able director, Dr. Stratton, whose name is now a household word. May the bureau long continue to have success under his wise direction. The letter follows:

Cambridge, 1892, Jan. 13.

My dear Sir:

Your article on a National Physical Laboratory came duly, and I thank you for sending it to me. By this mail it goes back to you.

I have read it with care and much pleasure, and trust that you may soon publish it, for it can not fail to be useful. What may be the best way to bring it before the public I do not know; but, from my limited means of judgment, it seems to me that some one of the great New York magazines might afford a good opportunity —say the *Century,* or *Scribner's.* I should select a periodical of large circulation—and not a "popular scientific" one, where the public reached is one which would in general require no education on the subject, or else not to be of the influential class of people.

And when it is printed, I hope you will take steps to insure that members of Congress and professors of physics in our leading universities shall have opportunity to read it. Possibly some of the engineering journals might have the sort of circulation which is desirable.

Wishing you all success, and with cordial sympathy with such a movement, I am,

Very sincerely yours,

B. A. GOULD

Dr. Arthur G. Webster,
Worcester.

A. G. WEBSTER

WORCESTER,
JULY 8, 1922

SPECIAL ARTICLES

BASAL GLAUCONITE AND PHOSPHATE BEDS

As a result of lithologic studies of carboniferous formations in Texas I showed last year[2] that glauconite beds characterized by certain peculiarities occur at breaks in a sedimentary series. Although I pointed out that this observation was merely an extension of Cayeux's observation[3] that phosphate beds occur in similar positions, I thought at the time that the relation of typical glauconite beds to these breaks had not been noted. I was therefore much interested to learn in conversation re-

[1] Published with the permission of the director of the U. S. Geological Survey.

[2] Goldman, Marcus I.: "Lithologic Subsurface Correlation in the 'Bend Series' of North-central Texas," *U. S. Geol. Survey Prof. Paper* 129-A, pp. 1-22 (especially pp. 3-4), 1921. "Association of Glauconite with Unconformities," *Bull. Geol. Soc. America,* 32, p. 25, 1921 (abstract).

[3] Cayeux, L.: *Contribution à l'étude micrographique des terrains sédimentaires, Mém. de la Soc. géol. du Nord.* 4 pt. 2, pp. 427-432, 1897. *Genèse des gisements de phosphates de chaux sédimentaires, Bull. Soc. géol. de France,* 4e ser., *5,* pp. 750-753, 1905.

cently with Professor W. G. Fearnsides, of Sheffield, England, that the association was familiar to him and had been described by him in print. He mentioned a number of other occurrences and gave in addition several references to British publications which discuss the relation of phosphate beds to stratigraphic breaks. As all this evidence serves to establish the principle on a solid basis it seems worth while to bring it to the attention of American stratigraphers.

The deposit of basal glauconite described by Fearnsides[4] and Anderson[5] is at the boundary between the Cambrian and Ordovician of Sweden and is very extensive. Another deposit of wide extent, described by Hayes,[6] is at the boundary between the black Chattanooga shale and the overlying carboniferous in Tennessee. Both of these are associated with phosphate. The association of glauconite and phosphate is, in fact, so generally referred to in the literature relating to either of them, especially in that relating to nodular phosphate, that it may be regarded as established. Anderson[7] not only recognized it but interpreted the relative abundance of one or the other. He formulated the principle that in deposits of the two constituents phosphate predominates in the littoral facies and glauconite in the offshore shallow-water facies (essentially the continental shelf). If this practical equivalence in mode of occurrence of glauconite and phosphate is recognized, then the papers referred to in this note, although most of them deal with phosphate deposits, serve to establish beyond reasonable doubt the association of certain types of glauconite as well as of phosphate deposits with breaks in a stratigraphic succession. As early as 1874 Tawney[8] stated that the fossils in a phosphate bed represent a long time range, indicating a dearth of sedimentation. The development of the conception with various modifications may be followed in the references given. In a very recent paper Vaughan[9] points out the possible bearing of a glauconite bed in solving the problem of the position and character of the Mesozoic-Cenozoic boundary in New Zealand.

Two conclusions seem to have impressed themselves on most students of these basal deposits of phosphate and glauconite: One is that the surfaces on which they occur had not emerged, the other that they represent a long-time interval.

The reasons for supposing that there has been no emergence are not always very clearly formulated. The principal ones seem to be: (1) The usual absence of any *recognizable* erosion surfaces underlying the deposits; (2) The absence of an underlying weathering surface; (3) The absence of fragments of the underlying bed; (4) Lack of evidence of transportation of constituents of the beds; (5) The fact that similar modern deposits form under purely submarine conditions.

There seems to be room for many fallacies in these assumptions, and at best the demonstration of the fact they are called upon to prove—that during the interval between the formation of the underlying and overlying bed there was no emergence—does not appear very essential. A long period during which the sea bottom was at or near marine base-level seems to be implied in any case, and that, so far as I can see, implies also an approximation to subaerial base-level of the adjacent land. Slight oscillations of base-level may safely be assumed and are indicated by some of the evidence. Whether these fluctuations have at times brought part of

[4] Fearnsides, Wm. G.: "The Lower Ordovician Rocks of Scandinavia," etc., *Geol. Mag.*, n. s., Dec. 5, 4, pp. 257-267, 295-304 (especially pp. 264-267), 1907.

[5] Anderson, J. G.: *Über Cambrische und Silurische phosphoritführende gesteine aus Schweden, Bull. Geol. Inst. Univ. Upsala*, 2, pp. 133-236 (especially pp. 178-200, 220-229), 1895.

[6] Hayes, C. W.: "The Tennessee Phosphates," *Sixteenth Ann. Rept., U. S. Geol. Survey*, pt. 4, pp. 611-612, 1895; *Seventeenth Ann. Rept., U. S. Geol. Survey*, pt. 2, p. 523, 1896.

[7] Anderson, J. G.: *loc. cit.*, p. 221.

[8] Tawney, E. B.: "Notes on the Lias in the Neighborhood of Radstock," *Proc. Bristol Nat. Soc.*, n. s., 1, p. 174, 1874.

[9] Vaughan, T. Wayland: "Correlation of the later Mesozoic and Cenozoic Formations of New Zealand," *Proc. First Pan-Pacific Scientific Conference*, Pt. 3, Bernice P. Bishop Special Publication, pp. 734-737, Honolulu, 1921.

the area, in which phosphate is found, above water makes little difference. The essential fact is that the phosphate nodules and most of the materials associated with them probably accumulated mainly in place and not as a result of transportation.

The length of the period during which the deposits accumulated is deduced from the following facts: (1) The wide range of the fossils they contain; (2) The great thickness of the "equivalent" section in other areas. Without the fossils this has no bearing; (3) In modern deposits of similar character the decomposition of associated detrital minerals and evidence of prolonged submarine exposure of other constituents; (4) The abundance in the deposits of bore holes made by submarine animals; (5) The evidence of different stages in the formation of the nodules; (6) Differences in the amount of wear on different nodules, indicating formation at different times; (7) The fact that the sand included in the concretions is finer than that in the matrix, indicating a range of conditions; (8) The abundance in the deposits of the teeth of fish without their bones, the bones having been dissolved.

One of the most convincing arguments involves a consideration of the origin of the deposits and the reason for their association with stratigraphic breaks. This is not the place for attempting a complete discussion of the problem, but one explanation formulated or implied by several of the papers cited is so convincing in its simplicity that I wish to state it briefly as superseding the one which, following Cayeux, I proposed in my previous papers. This new explanation is based on the peculiar composition of the glauconite and phosphate beds at stratigraphic breaks. A definition of these peculiarities is almost an explanation of them—they are essentially concentrations. The materials concentrated as I have described them and as they are described in part by Fearnsides and others include the glauconite and phosphate grains and nodules themselves, shells or coarse fragments of shells of marine animals, sulphide concretions, etc. These same constituents are found in the overlying bed and in some localities also in the underlying bed. The reason they are concentrated here is apparently that no detrital material accumulated to separate them. In Teall's picturesque words,[10] "The deposition of sediment acts on the zonal succession [of ammonites] and on the distribution of phosphatic matter very much as a prism acts on the rays of light. It supplies a kind of dispersive power." So far as my reading goes, Hayes[11] is the only one who has made the important deduction from this interpretation that the scarcity of calcareous shells must then be accounted for. He attributed it to solution, which accounts also for the dominance of phosphatic skeletons, the lime phosphate being less soluble than the carbonate. Otherwise the abundance of living phosphatic organisms such as the brachiopods, which usually characterizes these areas of phosphate deposition, would be hard to explain, seeming to imply a puzzling selective action of the environment on the fauna. Murray and Renard[12] noted on the one hand the occurrence of glauconite and phosphate deposits in areas of slow sedimentation, and on the other hand the presence of glauconite, though in much smaller relative amount, in many types of more rapidly accumulating deposits, such as the Blue Muds. But apparently they did not associate the abundance of the glauconite and phosphate with the mere scarcity of the sediment.

It is perhaps surprising that a fact so long and frequently recognized as this association of phosphate and glauconite with stratigraphic breaks should have failed almost completely to penetrate the text-books. I have found it touched on only in Grabau's "Geology of the Non-metallic Minerals."[13] Nevertheless, though it still requires a great deal of interpretation and qualification, it seems to be established well enough to receive general consideration from stratigraphers as a criterion of great possible value in the analysis of stratigraphic sections.

MARCUS I. GOLDMAN
U. S. GEOLOGICAL SURVEY

[10] Teall, J. J. H.: "The Natural History of Phosphatic Deposits," *Proc. Geologists' Assoc.*, London, 16, p. 379, 1900 (bibliography of 45 titles).

[11] Hayes, C. W., *loc. cit.*, 1895, pp. 621-622.

[12] Murray, John, and Renard, A. F.: "Deep-sea Deposits," Report on the Scientific Results of the Voyage of H.M.S. *Challenger*, pp. 382 and 411, 1891.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

SECTION E—GEOLOGY AND GEOGRAPHY AND ASSOCIATED SOCIETIES

The American Association for the Advancement of Science and Canadian Geology: A retrospect: W. G. MILLER, provincial geologist, Toronto, Ontario. The working together of Canadians and Americans in the association has done much to promote pleasant relations between the two countries and to advance science. When the association was founded, over seventy years ago, prominent Canadian geologists were among its first members and contributed important papers, some of which, especially that one which introduced the terms Huronian and Laurentian have become classic. Certain views held concerning the age relations of pre-Cambrian rocks in the earlier years of the association are contrasted in the paper with those which are at present current.

Some physiographic forms of western North Dakota: HARRY N. EATON. Illustrations of the Bad-land topography of the Little Missouri River Valley; the Missouri River escarpments and flood plain, with erosional details of the Fort Union formation; the Missouri Coteau; the Altamont moraine; slump topography; clinker buttes, etc.

Mineralography or the microscopy of the ore minerals: ELLIS THOMSON, University of Toronto. The history of the study; technique and equipment employed in the preparation of polished sections; microscopic examination; microphotography and the practical application of the method.

A new genus and species of dinosaur from the Belly River beds of Alberta: W. A. PARKS. A description of a remarkable new genus of dinosaur found recently in the Cretaceous beds on the Red Deer River. It has a peculiar projection backward over the neck of the bone of the skull into a prong over four feet in length.

TUESDAY AFTERNOON SESSION, DECEMBER 27

This session was largely given up to the discussion of glacial geology.

The glacial period: its record in Iowa: GEORGE F. KAY. For many years Iowa has been recognized as one of the most important areas in the world for the study of the Glacial Period. Distinctive deposits mark five glacial epochs and four interglacial epochs. Attention is directed to the significance of the gombotils, which on account of their distinctive characters and wide distribution are considered to be among the best of horizon markers. They strengthen the view that the Glacial Period was probably hundreds of thousands and possibly millions of years in length.

Some recent and pleistocene glaciers of Argentina and Bolivia: A. P. COLEMAN.

The drumlins: COLONEL JOHN MILLIS. Since in the opinion of the writer the conditions favorable for drumlin formation are basin-shaped areas with impeded drainage, the radial movement of ice from these basins produced crevasses which became filled with water in summer. On freezing in winter, it produced pressure resulting in a buckling of the drift beneath the ice.

Stratigraphy and paleontology at Toronto: W. A. PARKS. The Paleozoic rocks in this district are overlain by the remarkable series of glacial and interglacial beds which have been formerly so fully described by Dr. Coleman and which contain evidences of interglacial epochs warmer than the present climate of the region. The Paleozoic rocks which consist of shales and limestones are exposed at a few rather widely separated points and while there are some variations in the fossil characters indicating different zones there are no physical unconformities in the series.

Outline of the physiographic history of northeastern Ontario: W. H. COLLINS. A summary of the data showing what important diastrophic movements have occurred in this area and the evidence which fixes the periods in which these revolutions have occurred.

WEDNESDAY MORNING SESSION, DECEMBER 28

Address of Dr. Eliot Blackwelder, the retiring vice-president of the section, on "The Trend of Earth History."

The remainder of the morning session was mostly taken up with papers bearing on sedimentation.

Sedimentation in Lake Louise, Alberta: W. A. JOHNSTON. The sediments being formed in the lake are glacial silts derived from Victoria glacier near the head of the lake. Conditions of sedimentation are somewhat similar to those which existed in northwestern America at the close of the Ice Age. Core samples from the bottom of the lake taken by means of a bottom sampler and sounding machine show fairly distinct banding believed to be seasonal.

A natural classification of sedimentary rocks: RICHARD M. FIELD. Owing to the increased

[1] Toronto, December 27, 1921.

interest in the study of clastic rocks, new terms are needed to describe new phenomena. For instance, conglomerates may differ greatly—not only as to compositions but also as to origin, and the phenoclasts should not always be called pebbles. The petrogenesis of the sedimentary rocks is intimately related to paleogeography and paleobiology. The paper is a suggestion that more attention should be paid to the "life-history" of sedimentary rocks.

The Pre-Cambrian of western Patricia: E. M. BURWASH. A summary and comparison of the pre-Cambrian complexes of the Lac Seul region and of the Manitoba boundary north of the Winnipeg River.

WEDNESDAY AFTERNOON SESSION, DECEMBER 28

Some of the physico-chemical properties of colloidal solutions and their relation to geological processes: E. F. BURTON. The study of colloidal solutions has to deal with the properties of suspension of small solid or liquid particles in such a liquid as water. Their geological importance rests on the conditions under which such suspensions are precipitated from their solutions, as, for example, in the formation of deltas and, also, on the curious effect of small traces of certain jelly-like substances on the properties of soils. Surface tension, electrical charges and molecular motions play a rôle in bringing about the stability of such suspensions and in regulating conditions of precipitation.

The present status of the medina problem in southeastern Pennsylvania: HARRY N. EATON. The Pennsylvania Geological Survey has investigated recently the extent of the ridge-making sandstone of the North or Blue Mountain in southern Pennsylvania, and the stratigraphic and faunal successions of the superjacent Silurian and Devonian strata on the north side of the mountain. Tentative conclusions were reached as follows: For over one hundred miles in extent the ridge-making sandstone is overlain conformably by the Clinton and probably is of Medina age, apparently correlating with the Shawangunk grit of the Delaware Water Gap region and western New Jersey. The upper Silurian and lower Devonian limestones of the New York State series were not deposited over the area immediately north of the mountain, the Cayuga shale lying directly below the Hamilton sandstone as far east as the Lehigh Gap; isolated exceptions being a thin band of Helderberg-Oriskany chert west of the Susquehanna River valley, and a thin Onondaga limestone bed in Schuylkill County, east of Swatara Gap.

The session then adjourned for a visit to the Royal Ontario Museum under the leadership of Dr. A. P. Coleman and Dr. W. A. Parks.

THURSDAY MORNING SESSION, DECEMBER 29

The Mackenzie River Basin: D. B. DOWLING. The basin of the Mackenzie River is underlain by Devonian limestones and shales thinly covered by Cretaceous and Tertiary sediments. The shales and dolomites underlying the upper Devonian limestones are of Middle Devonian age and in places are petroliferous. The area which may be considered as forming a possible oil field consists of a belt showing comparatively little disturbance between the crushed and metamorphosed zone of the Rocky Mountains and the overlap of the Paleozoic on the Archean to the east. The field is divided by a line of folds which may be considered a spur of the mountains which cross diagonally in a north and south direction. The eastern part exposed around Great Slave Lake is comparatively undisturbed. The portion west of the mountain spur shows signs of partaking in the earth movements. A triangular area with upturned edge next the mountains shows minor crumplings or lines of anticlines in a general east and west direction near the northern border. These terminate to the east in a probable fault line or line of breaks in which the downthrow is on the east side with the upthrow on the west side showing only in the ridges which are anticlinal in section. The surface east of this line of breaks is a flat plane, covered by Cretaceous, Tertiary and later sediments leading to the hills of the Franklin range to the east. The Devonian shows erosion previous to the deposition of what is probably Upper Cretaceous. Denudation of the Cretaceous is indicated previous to the deposition of the Tertiary and in this interval nearly all the mountain building took place since the Cretaceous is uplifted with the Devonian and the Tertiary but slightly tilted. The structure of the basin included within the pressure folds that bound the part of the oil field west of the Franklin range must be interpreted mainly from the Cretaceous measures assuming that the unconformity with the Devonian was a planation of horizontal beds near sea level. The Tertiary basins represent down warpings of the plane underlain by Cretaceous which was to base level of erosion at the inception of the mountain building. Southward Cretaceous sediments are present in great masses and form thick deposits which were elevated by the earth stresses and now form the plateaus of the plains to the south. The Cretaceous measures against which the pres-